Shape evolution of three dimensional flower-like gold microstructures from gold nanosheets via oriented attachment

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Abstract: Herein, we present a shape evolution of 3 dimensional flower-like gold microstructures (3D-FLGMSs) from gold nanosheets induced by H$_2$O$_2$ with the presence of starch. A systematic investigation of the influences of the parameters on the size, morphology and structural evolution of 3D-FLGMSs was presented. Under the starch-stabilized environment, H$_2$O$_2$ plays a key role on the formation of 3D-FLGMSs as it promotes a rapid generation of small nanosheets with starch-bound {111} facet at the very early stage. At a high concentration of H$_2$O$_2$, the nanosheets undergo oriented attachment and transform into a large primary gold nanosheets with imperfect facet-binding. The oriented attachment (OA) and subsequent epitaxial growth of nanopetals from the imperfects turns the primary nanosheets into 3D-FLGMSs with lateral size as large as 30 µm within 120 min. Without starch, quasi-microspheres of gold with diameters of 5–7 µm are the sole product. In Addition, the 3D-FLGMSs can be employed as SERS substrates which allow the detection limit of Rhodamine 6G (R6G) at the concentration as low as 0.1 µM. The developed green synthetic method utilizes non-toxic reducing and stabilizing agents while limiting the discharge of harmful chemical wastes.

Keywords: Flower-like gold microstructures; Gold nanosheets; Hydrogen peroxide; Oriented attachment; SERS